RM96xx
Radio Modem Series

User Manual

Table of Contents

Main features and brief description 2
Additional Information on Power Supplies/Antennas 3

Modes of Operation
- Primary Modes 4
- Repeater Modes 5
- Hayes Mode 7
- Serial Control Mode 10

User Control & Configuration
- User Controls 13
- Table of User Settings 14
- Explanation of Features 15

Timing Diagrams 16
Specifications 17
Serial Port Connections 18
Softward Release Information 18

RDT does not assume any responsibility for the use of the products described. No product patents are implied and RDT reserves the right to change the said products without notice at any time.

RM96xx
Radio Modem Series

User Manual

Features

- UHF FM Synthesised Radio Transceiver
- Transparent serial data transmission
- RS-232 & RS-485 Serial Data Interfaces
- 6 modes of operation including Asynchronous, Modem and Repeater
- User selectable RF channel, Address and Tx power level
- LED indicators for radio functions, signal strength and serial line status
- Forward Error Correction (FEC)
- Automatic Repeat Request (ARQ)

Brief Description

The RM96xx Series of Radio Modems are a range of UHF multi-channel transceivers, incorporating a GMSK baseband modem and RS232/RS485 serial data interfaces.

As with all RDT Radio Modem products, the RM96xx provides fully transparent operation regardless of the serial data protocol. Over-air speeds up to 16Kbps are achieveable and serial data can be input at various baud rates up to 19,200bps.

Access to all user configurable parameters is possible using the on-board switches and operational status is easily monitored using the standard LED indicators.
Models currently available include the RM96xx Modem Card for OEM customers, the RM96xxB Aluminium housed model and the RM96xxE & EX, IP67 housed units with integral power supplies.

A brief summary of features includes addressing capability, user selectable RF power level and frequency of operation, built-in repeater facility, Forward Error Correction (FEC), Automatic Repeat Request (ARQ), MODBUS compatibility (ASCII & RTU) and Hayes Compatible mode.

The RM96xx utilises RDT's unique multi-channel UHF transceiver which is available as a separate module to OEM customers wishing to take advantage of the superior design, built quality and performance for which our products have a world-wide reputation.

Applications include Alarm Systems, Data Acquisition, Remote Metering, Remote Control Systems, Warehousing and Despatch, SCADA, Security Systems, Video Surveillance Systems, Telemetry, Traffic Information and Control Systems etc.

The RM96xx products carry the CE mark and meet various UK, European and world-wide radio approval specifications including ETS 300 113, ETS 300 220 AND MPT1329. Details are available upon request.

Additional Information

Power Supply

The RM96xx board requires a 12V d.c. power supply which should be well filtered and regulated. On-board voltage regulator circuits will maintain a constant supply of voltage to the radio and logic circuits, however, excessive noise, fluctuations and interference on the d.c. supply may cause loss of data.

Antenna Selection

The antenna should be designed for use at the operating frequency in the 406-470MHz UHF frequency band. The radio range achieved will be dictated by the land topography between the nodes. Ranges quoted below are for guidance only, distances vary according to terrain and obstructions. In many situations increasing atenna height can greatly improve signal strength, and the RSSI test mode can be used for signal strength indicated. Yellow LEDs indicate minimum acceptable signal, green LEDs indicate excellent signal strengh.

Coaxial feeder cable is available in many forms, 50 ohm impedance cable with low loss should always be used, note that 3dB of feeder loss will reduce radiated power by half. In some applications where maximum range is required, directional antennae with gain can compensate for feeder loss provided that the maximum radiated power limit is not exceeded.

When low loss RG213/U or UR67 coaxial cables are employed N-type RF connectors should be fitted in conjunction with one of the Antenna Bulkhead Cable Kits to convert from the SMA of BNC socket on the radio module to N-type RF connectors on the coaxial cable.

Antenna Type	Range	Coverage	Gain	Mounting	Applications
1/2-Wave Whip	1 km	Omnidirectional	-3dB	Enclosure Mounted	Short range general use
End-fed Dipole	10 km	Omnidirectional	0dB	Pole Mounted	Medium range general use
8 Element Yagi	20 km	Directional (40°)	10dB	Pole Mounted	Long range, directional

Antenna Types

Primary Modes of Operation

Asynchronous Mode

In Asynchronous Mode data arrives through either the RS-232 or RS-485 serial port and is placed in the data buffer. As soon as data is detected in the buffer, the transceiver is switched to transmit mode. Once switched to transmit there will be a short delay (10mS), while the synthesiser locks and the transmitter reaches operating power. The data buffer is then inspected to determine the number of bytes available for transmission in this data packet. A small amount of header information (used internally by the receiving RM96xx) and the data bytes are then transmitted along with a 16 bit CRC. After this packet has completed transmission the data buffer is inspected to see if more data has arrived. If more data is available then the transmission process is repeated. When no more data is available the transceiver is switched to receive mode.

When an RM96xx header block containing the appropriate modem address, size of data packet and valid CRC is received then the number of bytes specified in the header block will be read into the data buffer and then output to the RS-232 or RS-485 serial port.

Point to point, multidrop and repeater configurations are feasible in this mode.

Synchronous Mode

In Synchronous Mode timing constraints are imposed on the serial data. This mode is designed to be used in systems such as RTU MODBUS where the end of a message is determined by a gap in the serial data stream of 3.5 characters or more.
Data arrives through either the RS-232 or RS-485 serial port and is placed in the data buffer until a gap of $3^1/_2$ characters is detected in the serial byte stream. At this point, no more serial data can be accepted until the stored data has been transmitted. The transceiver is then switched to transmit and the contents of the data buffer with a header block are sent as a single data packet. The transceiver is then switched to receive mode.

Following reception of a valid header block for synchronous mode, the data packet received is placed into the data buffer. When all the data is in the buffer it is output synchronously to the serial port to ensure no gaps appear in the serial data stream.

Point to point and multidrop configurations are feasible in Synchronous Mode.

Modem Mode

In Modem Mode the transceiver is controlled with the CTS/RTS control line. To transmit, the CTS input must be taken high. When the synthesiser has locked and the transmitter reached operating power the modem will set RTS output high. This signals the user that the RM96xx is now available to accept serial data. Once RTS is raised, the RM96xx will operate in accordance with Asynchronous mode with the exception that the transceiver will stay in transmit until the user lowers CTS.

Note: The diagrams of pages 16 & 17 provide timing information on each of the above modes.

Repeater Modes

From time to time it is necessary to include a repeater in a system for the following reasons:-

- To extend range
- To circumvent obstacles
- Achieving a radio link where circumstances dicate the use of less efficient antennas

A system using a repeater is inherently more complex than one without and it is recommended that first time users may wish to discuss the details of system operation with their modem supplier.

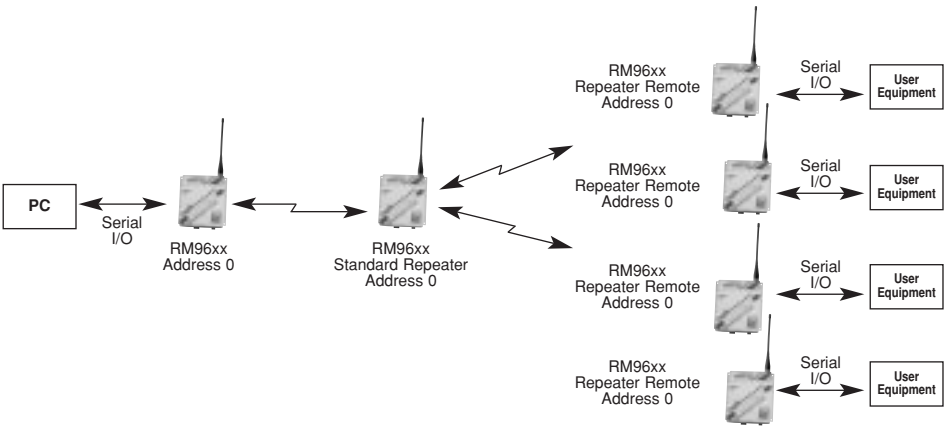
Repeater Modes

The RM96xx series modems have three repeater modes, Standard, Repeat All and Automatic Repeat. These are selected by the normal programming method with the rotary switch in position 3 and using DIL switches 4, 5, 6 and 7.

Standard Repeater

In the Standard Repeater mode all RM96xx units within the system must be set to the same address. The base unit is configured as a standard unit, the repeater is set to 'Standard Repeater' and the remote units must be set to 'Repeater Remote' (see page 14 for switch settings).
The base unit transmits data with a standard header block. To avoid unneccesary interference and the possibility of the remote units interpreting the base station transmissions, the remote units will not accept messages with the standard header block.
When the repeater receives data from the base unit, the header block is changed prior to re-transmission so that the remote units will recognise the transmission.
In the same manner, a remote unit can only transmit data back to the base station via the repeater which changes the header block to the standard acceptable by the base unit.

Standard Repeater



Notes
An RM96xx in Standard Repeater Mode will receive data from normal RM96xx units or from Repeater Remote Units providing they are set to the same address.

A normal RM96xx unit will not receive messages directly from a Repeater Remote.

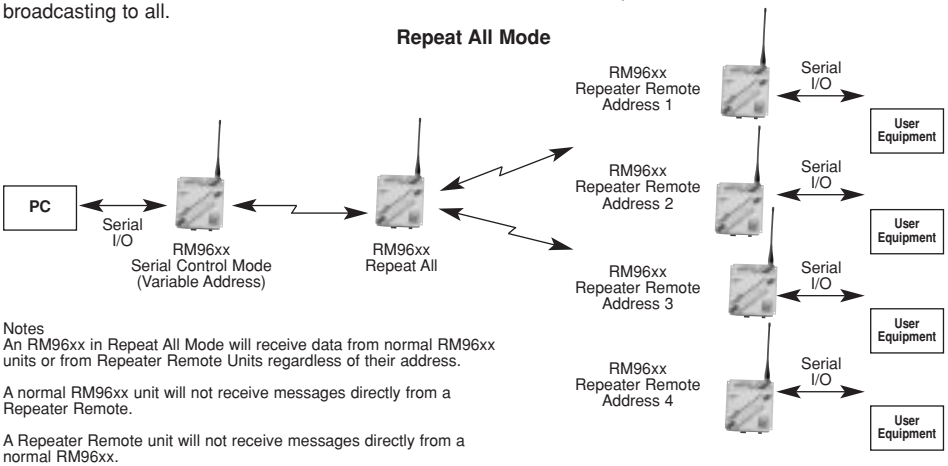
A Repeater Remote unit will not receive messages directly from a normal RM96xx.

... repeater modes continued

Repeat All

Repeat All mode is similar to the Standard Repeater mode with the exception that all valid RM96xx messages are repeated regardless of their address. This permits the use of a base station operating under Serial Control and enables the master to communicate with a specific remote modem rather than broadcasting to all.

Repeat All Mode



Notes
An RM96xx in Repeat All Mode will receive data from normal RM96xx units or from Repeater Remote Units regardless of their address.

A normal RM96xx unit will not receive messages directly from a Repeater Remote.

A Repeater Remote unit will not receive messages directly from a normal RM96xx.

Date sent from the Serial Control RM96xx will only be output at the Repeater Remote which is set to the same address.

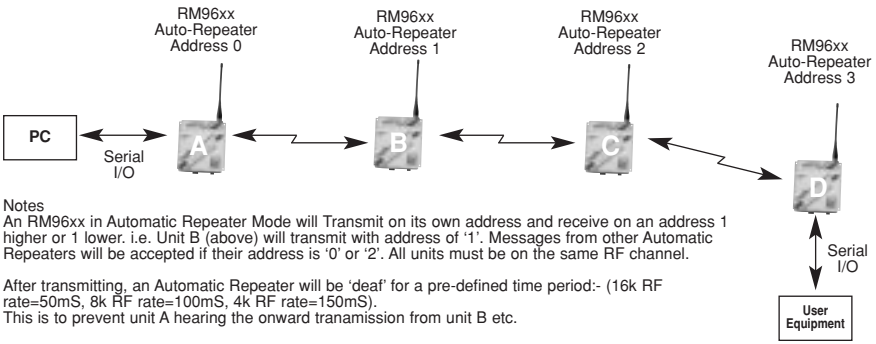
Automatic Repeat

Automatic Repeat mode allows a message to be automatically transmitted along a 'chain' of up to 255 repeaters. Each repeater has its address set 1 above its predecessor in the chain. Each unit 'listens' for messages from units with addresses 1 below or 1 above their own. (For example unit 6 will listen for messages from 5 and 7). When it receives a message from the higher of lower address it will re-transmit it on its own address. Having transmitted it will disable its receiver for approximately 50mS to prevent reception of the onward transmission.

A received message is repeated and output to the selected serial port at the same time. A message input at the serial port of any modem in the chain will travel along the chain in both directions.

Customers wishing to use this mode of operation should contact their distributor or RDT technical support for system planning assistance.

Automatic Repeater



Notes
An RM96xx in Automatic Repeater Mode will Transmit on its own address and receive on an address 1 higher or 1 lower. i.e. Unit B (above) will transmit with address of '1'. Messages from other Automatic Repeaters will be accepted if their address is '0' or '2'. All units must be on the same RF channel.

After transmitting, an Automatic Repeater will be 'deaf' for a pre-defined time period:- (16k RF rate=50mS, 8k RF rate=100mS, 4k RF rate=150mS).
This is to prevent unit A hearing the onward tranamission from unit B etc.

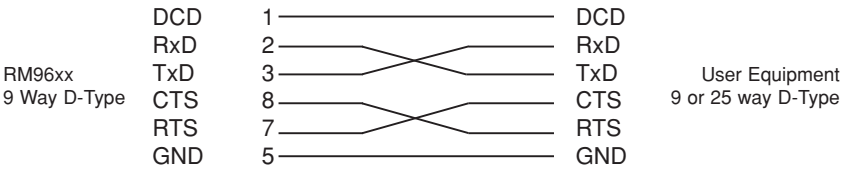
Hayes Mode Operation

Introduction

When operating in Hayes Mode, the RM96xx Series of Radio Modem products accepts and responds to a subset of the world industry standard AT command set.
This permits a wide variety of systems primarily intended for PSTN operation to function over a dedicated radio link without any changes to the system software.

As an intelligent data communications device, the RM96xx analyses and executes commands sent to it as strings of ASCII characters. Provided that an appropriate communications program is active on the computer, you may enter AT commands at the keyboard. Otherwise, you may issue commands through a program in any programming language.The RM96xx returns messages in ASCII string format.

Connection Diagram



Operational Overview

Three system configurations are possible using the RM96xx series in Hayes mode, these are, Point-to-Point, Polled Network and Random Network.

Point-to-Point

Used in this configuration, a connection can be established which allows bi-directional data transfer between two points. Either point can initiate the connection process.

Polled Network

In this configuration, the same RF channel is used by all modems in the network. The connection and data communication process is handled by one master modem which connects to each remote modem in turn, communicates using bi-directional data transfer, and then 'hangs-up'. This procedure can then be repeated for all modems within the network.

Random Network

This configuration is similar to the polled Network with one exception; in addition to the master modem being able to initiate the connection process, any of the remote modems can attempt to connect when the RF channel is free.
It should be noted that significant delays in overall system performance are possible when using the Random Network configuration due to the lack of control within the system.

... hayes mode continued

System Operation

Each RM96xx has a user configurable address in the range 0-255 which is set via an on-board dil switch. This address is effectively the *telephone number* used by the master station or another remote station when initiating a connection between two units.

As an example, the text string ATDT141 will initiate a connection sequence to the RM96xx with address 141. If no connection can be made the RM96xx will respond with NO CARRIER.
If a successful connection is made, the Carrier Detect LED, D1, illuminates signifying that a current connection is in progress and the DCD line is raised (pin 1 RS232 connector).
Data is then transferred Asynchronously and is terminated by a standard hangup sequence such as +++ ATH0, which drops the DCD line and turns off LED D1.
A detailed description of Asynchronous data transfer can be found on page 4.

Selecting Hayes Mode

To select Hayes mode, set the rotary switch (SW2) to position 8, set DIL switch position 1 to ON and press the 'Store' button.
When Hayes mode has been selected, the RM96xx will send and receive data Asynchronously. No other operating mode can be selected.
In addition, the following functions are disabled when in Hayes mode: Serial Control, All Repeater Modes, ARQ Modes.
The software has been designed to automatically de-select any of the above modes when the Hayes mode is selected.

AT Commands Supported

The following AT commands are supported:- ATA, ATD, ATDT, ATDP, +++, ATH, ATH0,
ATSn=m registers supported are;
(defaults in brackets)

S0=x	Auto answer	(on)	x=0 for off, x=1 for ON
S2=x	Esc Code Character	(+)	Enter the Decimal ASCII value
S7=xx	Wait for Carrier	(30s)	Enter Wait for Carrier in seconds
S12=xx	Esc Guard Time	(1s)	Enter in units of 1/50th Second (i.e 50 = 1 second)
(No Echo)			

Standard RM96xx Responses

The following responses will be provided by the RM96xx to AT commands;

ERROR, RING, CONNECT, NO CARRIER, BUSY, OK

Notes

i) The structure of all AT commands is understood and those not implemented answer OK.
ii) If there is no RS232 activity for 30 secs, the modem 'hangs-up' and drops the CD line.
iii) When dialling (ATDxxx), the recipients address (xxx) MUST contain three digits.
iv) Every Modem in the Hayes network must have a unique address.
v) A modem in Hayes mode will ignore any data from a modem NOT in Hayes mode.
vi) The RS232 serial port is disabled while waiting for a connection after dialing (see register S7).
vii) To hangup, after guard time send three Esc Code characters, wait for 'OK', send ATH0.
viii) ATA can be sent as a repsonse to 'RING' when not in Auto Answer mode in order to connect.
ix) All commands must be entered in UPPER CASE and terminated with a carriage return.

... hayes mode continued

Ring Indicator (RI) operation for the RM9600/9634

The following applies to RM9600 software version 2.5 upwards, and RM9634 software version 2.6 upwards.

Pin 9 of the RS232 connector is the Ring Indicator output when the modem is set to Hayes mode. It's operation is as follows:

If the modem is set to *non-autoanswer* mode (register S0=0), the RI line will be raised (+12V) on reception of an incoming call request and only be lowered (-12V) if any of the following conditions occur:

1. The call is answered by the reception of the string 'ATA<CR>' into the RS232 port. (<CR>=carriage return).

2. The 'Wait for Connect' timer at the sending end times out. (In this case the sending end clears the RI at the receiving end by sending a special header message).

3. 30 seconds have elapsed since the RI line first rose. (This ensures that the RI line is never left in the incorrect state).

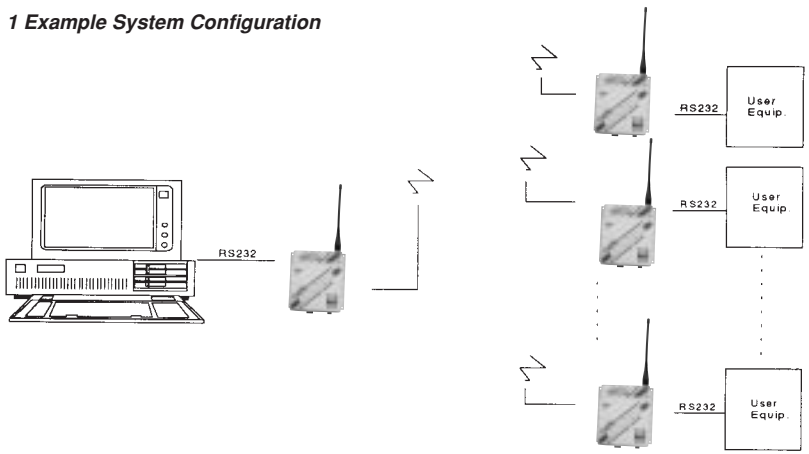
NOTE that if the modem is set to auto-answer mode (register S0=1 which is the default state), the RI Line does not change state, and remains low (-12V).

Serial Control Mode

Introduction

Selecting Serial Control mode permits various Radio Modem parameters to be interrogated and modified via the serial port instead of using the on-board DIL switches.
In some applications the user equipment takes care of addressing in which case an RM96xx operating in one of the standard modes can be utilised to provide a straight forward transparent serial data link.
In applications where the user equipment is not addressable, the address of the base station RM96xx will need to be changed to enable communications with remote units that are set to unique addresses. In applications such as this, Serial Control provides the solution.

FIG. 1 Example System Configuration



Operational Overview

A typical configuration is detailed in Fig.1 above. Basically, in a polled system with one master unit and several remote units the system operates as follows;

Each remote unit is a standard RM96xx with a unique address and/or RF channel set via the on-board DIL switches.
The master unit is set to operate in Serial Control Mode. It receives ASCII text strings from the host in a simple format which specify or interrogate it's address or RF channel number.
The master unit responds to the host with a reply string confirming the action or containing the value of the address/RF channel number currently set.

Serial data is transferred until a command is received to change to another address or RF channel.

In this configuration the master station can only listen to one remote station at a time. This is not a problem when using a polling system because the radio modems communicate with each other in pairs.

Global Addressing

Global addressing may be selected from software versions 2.4 (RM9600) and 2.5 (RM9634) onwards. This function allows a broadcast message to all stations in systems operating under serial control where messages are normally directed to a specific selected station. It is activated by sending the serial control command to select address 255 to the master station or any station that must broadcast to all others on the system.

... serial control mode continued

Configuring the RM96xx

Setting Serial Control Mode

Select Serial Control mode by turning the rotary switch (SW2) to position 3 and switching DIL switch SW1 position '3' to the 'ON' position.
Ensure that all the remaining DIL switches are set to the required positions before pressing the STORE button (SW3) to activate the settings.

Return the rotary switch to the '0' position when all options are configured.

Operation

Upon power-up the RM96xx will use the current DIL switch settings for Address and RF Channel. If the DIL switches are changed during operation then this change will overide the last serial command.

The serial commands will only work in RUN mode, with either of the following operational modes selected:-

Asynchronous Mode with or without ARQ
Synchronous Mode with or without ARQ

Set or Interrogate commands will only be accepted if the RM96xx has no data to transmit and no data to output on the serial port, otherwise they will be ignored and no response returned on the serial port. If there is no response to a command, programming has not been successful.

Note that an RM96xx can only be successfully reprogrammed when it has completed it's present data transfer.

The maximum time taken to program an Address is 2mS.
The maximum time taken to program a new RF channel is 15mS.

The responses to Address and Channel commands will occur within the times indicated above (assuming the commands were successful).

If the requested RF channel exceeds the maximum allowed (as defined by the radio), then the RM96xx defaults to the highest permissable RF channel.

Any input string that does not meet the command string format or specifies an address that is out of range will be treated as normal ASCII text and transmitted.

Guard Time

In some instances, the user's data may be the same as a valid command string which will cause problems with the system operation.
With a <GUARD TIME> selected, any command string must be preceded by a period of inactivity on the serial interface which is the same as or longer than the <GUARD TIME> selected. Each command is preceded by a <GUARD TIME>, the length of which is user selectable.

Users not wishing to use the <GUARD TIME> facility must select 'No Guard Time' from the options available.

ROTARY SWITCH = 7

SWITCH SW1	1	2	3	4	5	6	7	8
Description	SPARE	SPARE	Serial Control Guard Time		ARQ Retries	Global Address	SPARE	SPARE
Options			**OFF** **OFF = No Guard Time** OFF ON = 200 mS ON OFF = 500 mS ON ON = 1 Second		**OFF = 20** ON = Infinite	**OFF** ON		

Bold items denote factory defaults.

... serial control mode continued

Command Format
Serial Control mode allows the user to set or enquire about the value of an Address or RF Channel number. The command format for each of the functions is as follows:

Set Address

Send Text String	RM9600 Reply String	Function
<GUARD TIME>"A000	"A:000<CR>	Sets Address 0
<GUARD TIME>"A001	"A:001<CR>	Sets Address 1
<GUARD TIME>"A002	"A:002<CR>	Sets Address 2
<GUARD TIME>"A003	"A:003<CR>	Sets Address 3
" "	"	"
<GUARD TIME>"A255	"A:255<CR>	Sets Address 255

Note <CR> signifies a carriage return code

Interrogate Address

Send Text String	RM9600 Reply String	Function
<GUARD TIME>"A???	"A:xxx<CR>	Returns current address in xxx

Set RF Channel No.

Send Text String	RM9600 Reply String	Function
<GUARD TIME>"C000	"C:000<CR>	Sets Channel 0
<GUARD TIME>"C001	"C:001<CR>	Sets Channel 1
<GUARD TIME>"C002	"C:002<CR>	Sets Channel 2
<GUARD TIME>"C003	"C:003<CR>	Sets Channel 3
"	"	"

Up to maximum number of channels as specified in the EEROM

Interrogate Channel No.

Send Text String	RM9600 Reply String	Function
<GUARD TIME>"C???	"C:xxx<CR>	Returns current channel no - xxx

Notes

1. The command format is case sensitive - all commands must be in UPPER CASE.
2. Any character string not compliant with the above formats will not be recognised and will be transmitted as normal data.
3. Detection of the " character will cause the modem to re-sync it's 4 byte capture to the first byte of the string. This enables the modem to respond correctly following a character loss.
4. Each command is preceeded by a <GUARD TIME>, the length of which is selectable with the rotary and DIL switches.

User Controls

Factory Settings

The RM96xx is shipped from the factory pre-programmed to operate with the following settings:-

Serial Port	
Mode	Async, FEC On
Listen Before Tx	ON
Serial Port	RS232
Baud Rate	9600
Parity	None
Data Bits	8
Stop Bits	1
RF Parameters	
RF Channel	1
Power Level	500mW
Address	0
RF Data Rate	16K

User Configuration

Settings are altered by following 3 simple steps:-

1. Adjust Rotary switch (SW2) for desired function (see table 1)
2. Select required parameters using DIL switch (SW1)
3. Press 'STORE' button (SW3)

The above steps may be repeated for each Rotary Switch function indicated in the table on page 14. (refer to notes for exceptions to this rule)

To ease configuration, LED indicators D10-D17 display the current stored DIL switch settings for each rotary switch function, excluding functions '0' and '1'.

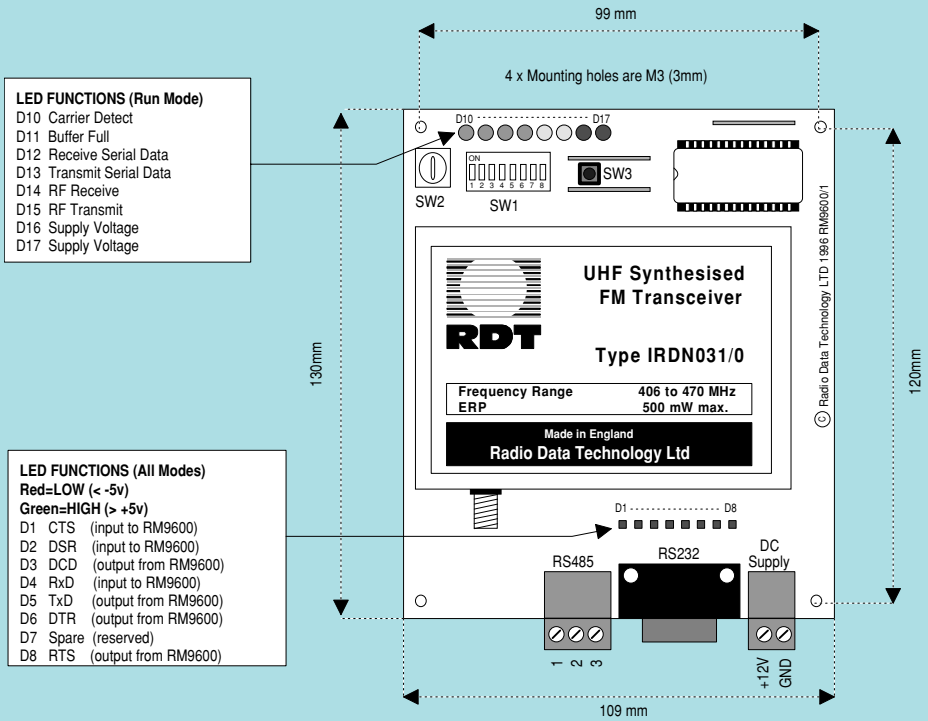


FIG. 2 RM96xx Radio Modem Board Layout

RM96xx User Configurable Settings

ROTARY SWITCH = 0

RUN MODE

1	2	SWITCH SW1
RF POWER		
OFF	OFF	50mW
OFF	ON	100mW
ON	OFF	250mW
ON	**ON**	500mW

3	4	5	6	7	8	
RF CHANNEL						
OFF	**OFF**	**OFF**	**OFF**	**OFF**	**OFF**	LOWEST FREQ
OFF	OFF	OFF	OFF	OFF	ON	
etc.	etc.	etc.	etc.	etc.	etc.	
ON	ON	ON	ON	ON	ON	HIGHEST FREQ

ROTARY SWITCH = 1

TEST

1	2	SWITCH SW1
TEST MODE		
OFF	-	Receive
ON	-	Transmit

3	4	5	6	7	8	
RF CHANNEL						
OFF	**OFF**	**OFF**	**OFF**	**OFF**	**OFF**	LOWEST FREQ
OFF	OFF	OFF	OFF	OFF	ON	
etc.	etc.	etc.	etc.	etc.	etc.	
ON	ON	ON	ON	ON	ON	HIGHEST FREQ

ROTARY SWITCH = 2

ADDRESS

1	2	3	4	5	6	7	8	
UNIT ADDRESS								
OFF	**OFF**	**OFF**	**OFF**	**OFF**	**OFF**	**OFF**	**OFF**	ADDRESS '0'
OFF	OFF	OFF	OFF	OFF	OFF	OFF	ON	
etc.	etc.	etc.	etc.	etc.	etc.	etc.	etc.	
ON	ON	ON	ON	ON	ON	ON	ON	ADDRESS '255'

Note: Address 255 is reserved for broadcasting a message in Serial Control mode. Please refer to 'Global Addressing' section of Serial Control on page 10.

ROTARY SWITCH = 3

OPERATING MODE

1	2	
PRIMARY MODE OF OPERATION		
OFF	**OFF**	ASYNC
OFF	ON	SYNC
ON	OFF	MODEM
ON	ON	N/U

3	4	5	6	7	8
SERIAL CONTROL	REPEATER ON/OFF	REPEAT ALL ON/OFF	AUTO REPEAT ON/OFF	REPEATER REMOTE	RS232/ RS485
	OFF-X-X = REPEATER OFF				**OFF = RS232**
OFF	ON-OFF-OFF = STANDARD REPEATER			**OFF**	
ON	ON-OFF-ON = AUTOMATIC REPEATER			ON	ON = RS485
	ON-ON-OFF = REPEAT ALL				

ROTARY SWITCH = 4

RF PARAMETERS

1	2	
RF BAUD RATE		
OFF	OFF	4K
OFF	ON	8K
ON	**OFF**	16K
ON	ON	N/U

3	4	5	6	7	8
LISTEN BEFORE Tx	FEC ON/OFF	ARQ ON/OFF	RTS/CTS HANDSHAKE	DSR/DTR H'SHAKE	ARQ TIMEOUT
OFF	OFF	**OFF**	**OFF**	**OFF**	**OFF= Std**
ON	**ON**	ON	ON	ON	ON= Extended

ROTARY SWITCH = 5

SERIAL INTERFACE CONFIGURATION

1	2	3	
SERIAL PORT BAUD RATE			
OFF	OFF	OFF	150
OFF	OFF	ON	300
OFF	ON	OFF	600
OFF	ON	ON	1200
ON	OFF	OFF	2400
ON	OFF	ON	4800
ON	**ON**	**OFF**	9600
ON	ON	ON	19200

4	5	
PARITY		
OFF	**OFF**	NONE
ON	OFF	EVEN
ON	ON	ODD

6	7	
CHARACTER LENGTH		
OFF	OFF	7 BITS
OFF	**ON**	8 BITS
ON	ON	9 BITS

8	
STOP BITS	
OFF	1
ON	2

ROTARY SWITCH = 6 UPDATE EEROM (See notes page 15)
ROTARY SWITCH = 7 SERIAL CONTROL (See pages 10-12)
ROTARY SWITCH = 8 HAYES MODE (See pages 7-9)
ROTARY SWITCH = F FACTORY SETTINGS (See notes page 15)

ROTARY SWITCH POSITIONS '9' TO 'E' ARE NOT USED

BOLD ITEMS DENOTE FACTORY DEFAULTS

Summary of Features

RF Channel
Binary coded RF Channel number. Refer to the frequency list supplied with each unit for corresponding frequency of operation

Address
Binary coded unit Address (0-255). Only units with the same address will communicate.

Test Mode
Receive LED's D10-D17 act as a received signal strength indicator in the form of a bar-graph. Yellow LED's indicate minimum acceptable signal, green LED's indicate excellent signal strength.
Transmit Unit transmits continuous modulated carrier.
These features can be used to ascertain the link quality between two units.

Operating Mode
Various operating modes can be selected. Please refer to the detailed description of each mode on page 4 before selecting.

Serial Control
This mode of operation permits the user to alter various RM96xx parameters via the serial port instead of using the on-board switches. A detailed description can be found on page 10.

Repeater
Please refer to the detailed description of Repeater operation on pages 5-6.

RF Data Rate
The RF data rate can be adjusted to improve range/ data integrity for applications that do not require high data rates. A low RF Data Rate will improve range a high RF data rate will reduce it.

Listen before Tx
With this feature 'OFF', the RM96xx will transmit serial data regardless of RF channel activity. If switched 'ON', the unit will only transmit when the RF channel activity is below that of the RSSI threshold. Otherwise data is buffered until the channel becomes free.

FEC (Forward Error Correction)
When selected, this feature will correct small data errors at the receiving RM96xx without having to re-transmit the data.
It should be noted that this feature will require an overhead to operate. Therefore, to achieve 9600bps transparently the RF data rate must be set to 16k.

Automatic Repeat Request (ARQ)
This feature can be enabled with any of the primary modes of operation with the exception of Modem Mode. When using ARQ, the primary mode operates in the same way as described on page 2 but each transmission is acknowledged by the receiving unit. If no acknowledgement is received within 500mS or a repeat request is received, the transmitter sends the data again up to a maximum of 20 times before moving to the next block of data.
ARQ can only be used in a point-to-point system or in a Serial Control system where all remote units have a different address. Standard Repeater systems can also use ARQ providing that the ARQ timeout feature is set to extended

RTS/CTS Handshake
This feature should be turned 'OFF' when the RM96xx is being used with a standard 3-wire connection to the user equipment (Tx, Rx, GND). This type of connection is the most common.
When switched 'ON', the RM96xx requires the CTS line to be controlled by the user equipment.
The RTS line will be lowered when there is only 256 bytes of space left within the transmit buffer and raised once again when the buffer is empty.
Lowering the CTS line causes the RM96xx to buffer any data received over the RF link. Raising the CTS line forces the RM96xx to output the serial data.

DSR/DTR
This feature can be used as a means of switching +/- 12V over the RF link.
Raising DSR (+12v) on one RM96xx unit will cause DTR on the receiving unit to also be raised. Lowering DSR (-12v) will cause DTR on the receiving unit to be lowered. The effects of raising/lowering the DSR line are immediate and are independant of any serial data activity.

USER CONFIGURATION NOTES
Rotary Switch position 6 (Update EEROM)
In this position it is possible for the contents of the EEROM within the radio to be modified. This is an engineering function and should only be performed with the appropriate software and technical support from RDT.

Rotary Switch position F (Factory Defaults)
Pressing the STORE button (SW3) with the rotary switch in this position will cause all current settings to be returned to the factory defaults listed on page 14.

Timing Diagrams

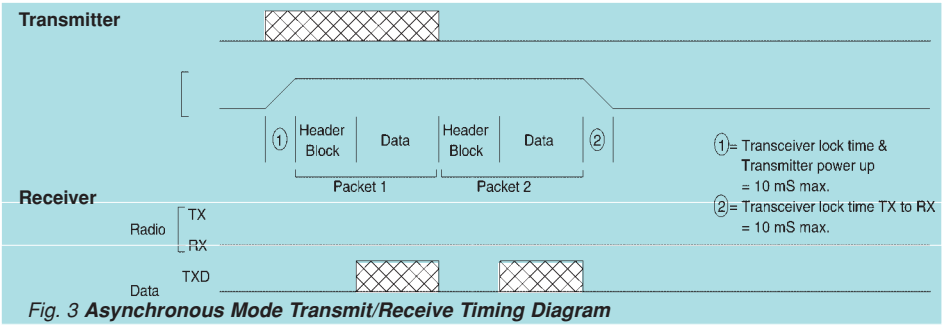


Fig. 3 ***Asynchronous Mode Transmit/Receive Timing Diagram***

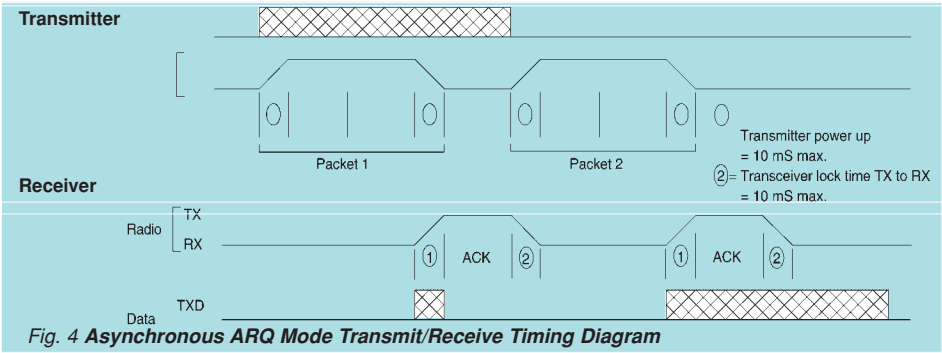


Fig. 4 ***Asynchronous ARQ Mode Transmit/Receive Timing Diagram***

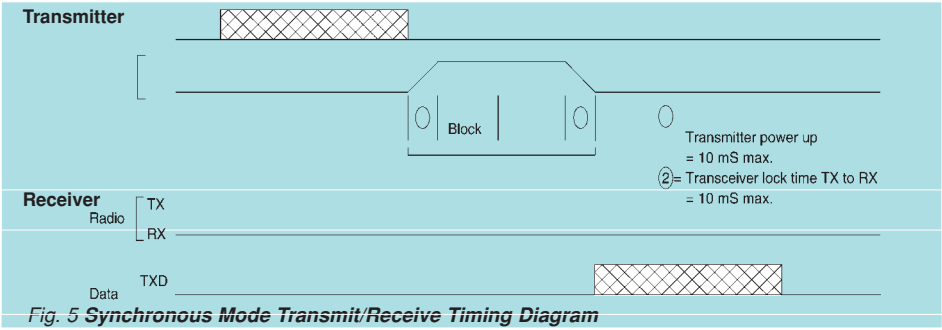


Fig. 5 ***Synchronous Mode Transmit/Receive Timing Diagram***

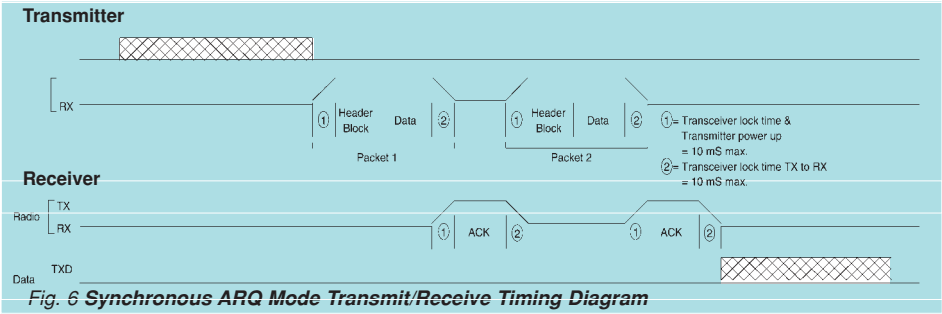


Fig. 6 ***Synchronous ARQ Mode Transmit/Receive Timing Diagram***

.... timing diagrams continued

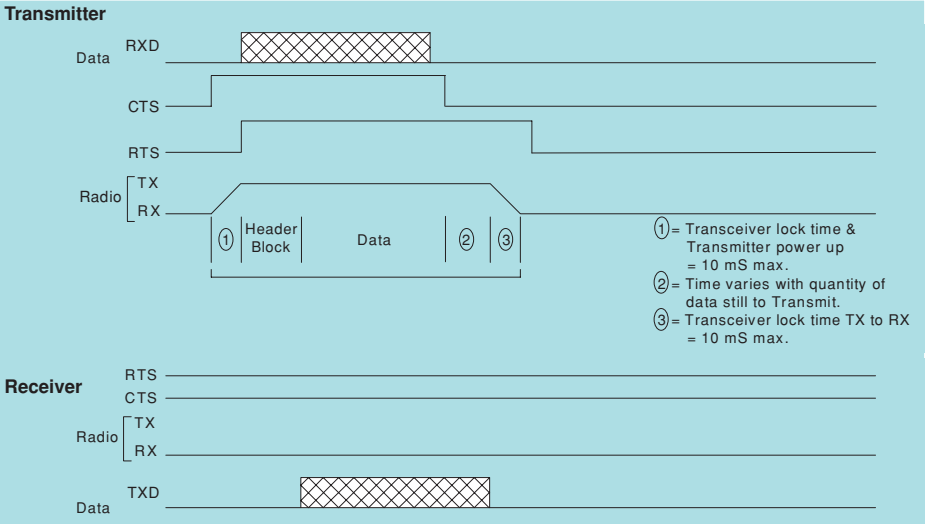


Fig. 7 ***Modem Mode Transmit/Receive Timing Diagram***

Specifications – Specific Models

RM9600

General

Frequency Range	10MHz band in the range 406 - 470 MHz
Channel Spacing	10, 12.5, 20 or 25kHz

Transmitter

RF Power Output	50 - 500mW (in 4 steps)
Adj. Channel Power	-37dBm
Freq. Tolerance	± 3ppm
FM Deviation	± 3.5kHz

Receiver

RF Sensitivity	- 110dBm for 10^{-4} BER
Intermodulation	-70dB
Adj. Channel Rejection	-70dB

RM9634

General

Frequency Range	10MHz band in the range 406 - 470 MHz
Channel Spacing	12.5, 20 or 25kHz

Transmitter

RF Power Output	50 - 500mW (in 4 steps)	
Adj. Channel Power	-37dBm	
Freq. Tolerance	± 1kHz	
FM Deviation	± 2kHz	
Intermod Attenuation	>40dB	
Spurious Emissions	<-36dBm	0-1 GHz
	<-30dBm	1-4 GHz

Receiver

RF Sensitivity	- 110dBm for 10^{-4} BER	
Co-channel Rejection	>-12dB	
Adj. Channel Selectivity	>60dB	
Spurious Response Rejection	>70dB	
Intermod Response Rejection	>70dB	
Blocking	>84dB for any signal >50kHz from the tune frequency	
Spurious Emissions	<-57 dBm	0-1 GHz
	<-47dBm	1-4 GHz

Specifications – All Models

RSSI Threshold Level	-105dBm at 16K -110dBm at 8K/4K	Interface Baud Rate	150-19.2 Kbaud, adjustable
		Parity	Odd, Even or None
Max. Bit Rate	16kbps (25KHz) 8kbps (10/12.5/20KHz)	Data Buffer	4 Kbytes Tx, 2 Kbytes Rx
		Stop Bits	1 or 2
Modulation	GMSK	Data Bits	7, 8 or 9

.... specifications continued

Mechanical & Environmental

Size	
RM96xx	130 x 109 x 32mm
RM96xxB	142 x 150 x 47mm
RM96xxE/EX	280 x 190 x 130mm
Weight	
RM96xx	400 g
RM96xxB	900 g
RM96xxE/EX	3.6 kg
Operating temperature	-25 to +60°C
Operating humidity	20% to 75% RH

Power Supply

RM96xx/B	
Power Supply	10.5 - 15.5V d.c.
Supply Current	Tx 550mA (500mW)
	Rx 260mA
RM96xxE/EX	
Power Supply	220-260V a.c. 50Hz
Supply Current	250mA max a.c.

RS232/RS485 Serial Port Connections

RS232/485

The RM96xx has two serial ports, a 9-Way 'D' Type connector (RS232) and a two part Phoenix connector (RS485). Connections are as follows:-

RS485 2-Part	Description
Pin 1	'B'
Pin 2	'A'
Pin 3	'GND'

RS232 9-Way 'D'	Description
Pin 1	DCD Data Carrier Detect
Pin 2	RxD Receive Data
Pin 3	TxD Transmit Data
Pin 4	DTR Data Terminal Ready
Pin 5	GND Ground
Pin 6	DSR Data Set Ready
Pin 7	RTS Request To Send
Pin 8	CTS Clear To Send
Pin 9	Rx Buffer Indicator

Pin 9 is the Ring Indicator (RI) when used in Hayes Mode, see page 9.

Software Revisions

RM9600 - STANDARD SOFTWARE (RM9600-1)

Date	Ver. No	Comments
11/11/96	V1.0	First Issue
26/11/96	V1.1	Data Integrity upgrade
26/03/97	V1.2	C23/C24 channel upgrade
02/04/97	V1.3	ARQ Sync. Mode upgrade
03/06/97	V1.4	20kHz Option
10/06/97	V1.5	Repeater functionality
15/09/97	V1.6	Rx interrupt upgrade
22/09/97	V1.7	Serial Control Mode ARQ Synch. Mode upgrade
04/11/97	V2.0	FEC OFF option ARQ - 20 retries or infinite Auto RF baud rate selection Serial Control 7 bit data
20/11/97	V2.1	Modem Mode operation
19/06/98	V2.2	485 Sync. Mode Upgrade
10/04/99	V2.3	Hayes Mode
29/07/99	V2.4	Global Addressing RF Data RX Indication Serial Control Parity upgrade
05/10/99	V2.5	Ring Indicator for Hayes Mode DCD Indication added

RM9600 V2.3 onwards requires RM9600-2 control board

RM9634 - STANDARD SOFTWARE (RM9634-1)

Date	Ver. No	Comments
20/11/97	V2.1	First Issue
03/06/98	V2.2	Optimise data handling
19/06/98	V2.3	485 Sync. Mode upgrade
10/03/99	V2.4	Hayes Mode
29/07/99	V2.5	Global Addressing RF Data RX Indication Serial Control Parity upgrade
05/10/99	V2.6	Ring Indicator for Hayes Mode DCD Indication added

RM9634 V2.4 onwards requires RM9600-2 control board

Notes

Notes

Radio Data Technology Limited
10-11 Taber Place Crittall Road Witham Essex CM8 3YP England
Telephone (01376) 501255 Telefax (01376) 501312
Internet: http://www.radiodata.co.uk email: sales@radiodata.co.uk

A member of the CML Microsystems Plc group

© 1999